

Article

Pioneering in Marginal Fields: *Jatropha* for Carbon Credits and Restoring Degraded Land in Eastern Indonesia

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Abstract: This paper highlights the role of a national Non-Governmental Organization (NGO) in Indonesia as “pioneer” actor in the *jatropha* global production network, linking solutions for local problems with narratives concerning global concerns. Analysis of previous activities of the NGO positions their *jatropha* project as one period in a sequence of donor-funded appropriate technology programs. On the island of Flores in Eastern Indonesia the NGO aimed to establish community based *jatropha* cultivation exclusively on “degraded land”, avoiding threats to food cultivation, and responding to local problems of land degradation and water resources depletion. In contrast with investors interested in *jatropha* based biofuel production for export, the NGO aimed at developing biofuel for local needs, including *jatropha* based electricity generation in the regional state-owned power plant. Anticipating progress in international and national regulations concerning the Clean Development Mechanism (CDM) the 2008 project’s design included carbon credit income as a main source of future project financing. Using methods of socio-legal studies and political ecology, this study indicates that when the economic feasibility of a project is based on the future financial value of a legally constructed commodity like carbon credits, the sustainability of the project outcome can be questionable. The author recommends precaution when it comes to including anticipated income from carbon credits in calculating the economic viability of a project, as price developments can fluctuate when political support and regulations change.

Keywords: appropriate technology; NGO; rural development; renewable energy; technology transfer; brokers; narrative; regulation

1. Introduction

Pioneering plant species are the first new settlers in degraded areas and the initiators of ecological restoration in a landscape. The Light of the Village Foundation (In. *Yayasan Dian Desa*, hereafter YDD) has been a pioneer in Indonesia's biofuel sector, trying to restore degraded land with jatropha. This article discusses its pioneering role in the emerging biofuel sector by answering three main questions. What were the main drivers for this Non-Governmental Organization (NGO) to start a jatropha project? How were these drivers included in the project narrative? How did these main drivers cause friction during the implementation phase?

In order to explore these questions, this paper discusses the case of YDD, an Indonesian NGO that proved to be a crucial actor in combining local issues with global narratives in an attempt to attract project financing for jatropha development. In the absence of biofuel infrastructure, the NGO has made important steps in linking upstream and downstream biofuel activities. The drivers of this jatropha project can be divided into two categories. First, jatropha fitted well within the appropriate technology paradigm on renewable energy. The second driver was the opportunity to gain future project financing through carbon credits.

The paper also explores how these drivers became linked to real life problems experienced on a daily bases in this rural area in Eastern Indonesia, such as land degradation and the depletion of water sources. This paper discusses how YDD managed to combine these local concerns and global drivers into a project proposal for jatropha development and what challenges were met along the way during implementation.

Keeping project activities in line with global and local development discourses, while fulfilling the requirements of the CDM project cycle proved to be problematic. Through exploring the experience of this NGO's jatropha project, the paper aims to contribute to the more general debate about to what extent the Clean Development Mechanism actually carried the potential for transferring clean technology and improving the economic viability of low carbon technologies in development countries in practice [1].

2. Conceptual Framework and Methodology

To answer these questions, a socio-legal approach was used [2,3], to analyze how law functions in society while taking a jatropha value chain as organizational unit of research. There can be various types of jatropha value chains, depending on the business model (e.g., whether production is for domestic use or export and the extent to which efforts are made to valorize side-products). This paper focuses on the development of a specific type of jatropha value chain at the district level where an Indonesian NGO made efforts to turn jatropha into a new agricultural commodity for local use, and demonstrates how these actors were influenced by rules from multiple levels of jurisdiction during the process. In doing so the "socio" is the point of departure: The actual activities and aspirations of actors in the biofuel network eventually determine the normative setting under analysis. In this case, the driver for YDD to obtain carbon credits draws attention to the normative settings around carbon governance [4] (p. 159).

This socio-legal approach is enhanced with insights from political ecology. The jatropha value chain is not yet a fully functioning production chain, compared to established agricultural commodities such as palm oil where primary producers are linked to end consumers, but a chain in the making. The process of imagining the chain is part of the commoditization process and involves various stages. Virtual markets and fictive commodities, however, create methodological challenges for analyzing the “green economy” [5]. Anna Tsing has provided useful insights into how to study global interconnectedness and the emergence of new commodities in “capitalist frontiers” through global connections [6,7]. This approach allows for an unconventional analysis of the jatropha value chain, shifting the focus from material products as in conventional commodity chain analysis (biofuel, press cake, *etc.*) to added value created by “discursive commodities”, including carbon credits and immaterial benefits such as a positive image through corporate social responsibility projects. In this case, the discursive commodities are created through the commoditization of nature [5,8]. Emission rights trading is made possible by putting a price tag on the carbon sequestration from the air in biomass through the process of photosynthesis. By translating the biochemical process into a marketable “ecosystem service”, trees produce intangible products besides biomass: “carbon credits”. Economic regulation at both the national and international level has an important role in the legal construction of such discursive commodities. When regulation changes, the market prospects of these commodities might change drastically.

This paper is based on an empirical case study, focusing on the perspective of one specific actor in the production network, an NGO, operating at the administrative level of an Indonesian district. To understand why jatropha seemed such an attractive idea for a next project from the perspective of YDD, it is important to understand how the NGO combined global narratives and local concerns into a specific project proposal. This case was selected because YDD is one of the most reputed NGOs in Indonesia with a long track record of development projects. Jatropha actors in the Indonesian jatropha network often mentioned the YDD project as one of the most successful jatropha projects in Indonesia, as it continued between 2008 and 2011, a period when the initial jatropha hype was already on its way down, as government projects initiated in 2006 and 2007 had failed.

The data was collected during various field visits to the district. The research location in the Sikka district was visited several times in 2010, 2011 and 2012, during which semi-structured interviews were conducted with local staff members of the Indonesian NGO, and the director of the Japanese NGO about project activities in the field. Additional to data from interviews and field observations, the analysis also includes textual analysis of the narratives in the project documentation required for the validation and certification of project emission reductions under the CDM scheme, including the Project Design Document [9] and the Feasibility Report of UFJ Mitsubishi Securities [10]. This empirical data is compared to the analysis of documents composing the normative framework for biofuel governance, including the Kyoto Protocol and related documentation about CDM methodologies as well as national law and regulations relating to the implementation of CDM in Indonesia. Literature review provided further insight in possible barriers related to CDM project implementation and jatropha based projects in particular.

3. Drivers Promoting the Pioneering of Green Technology by an NGO

With this case study, the paper would like to provide insight into why jatropha became an attractive option for new project activities for this specific type of NGO. The case is the story of an NGO in a remote area in Indonesia that adopted jatropha as a project in a long sequence of appropriate technology programs in order to improve people's livelihood. Several studies have pointed at the important role played by NGOs in the promotion of jatropha worldwide and the influence of global connections between NGOs and international donors. NGOs are portrayed as “strategic institutions”, linking donors, governments, private companies and local communities. Hunsberger pointed at the “[...] *early adoption and persistence of particular NGO's in promoting jatropha*” [11] (p. 944), cautiously suggesting the possibility that the need to attract funding for the continuity of the organization and the availability of donor funding for jatropha at the time, had played a major role in the early embracement of jatropha by NGOs. An element often overlooked in discussions on drivers that motivated actors to start a jatropha project is their value system. What made jatropha an attractive idea compatible with their organizational strategy and what narrative did the NGO create around jatropha projects to link the paradigms of climate change and technology transfer to their project activities?

The first driver that I discuss is that jatropha was very compatible with the paradigm of appropriate technology and fitted in the long-term strategy of the NGO towards rural development. The second driver was the perceived opportunity to get access to future project financing through carbon emission reduction trading.

3.1. Jatropha, Appropriate Technology and Rural Development

Jatropha fitted seamlessly in the philosophy of the NGO. YDD is an NGO with the vision that carefully selected appropriate technology will help poor people in rural areas to improve their livelihoods. Appropriate technology organizations are heavily influenced by the economic theories of Schumacher, which provided the impetus for a new rural development approach in the 1970s. Appropriate technology can be considered a counter-movement against large-scale top down development. Appropriate technology proponents plead for small scale projects fit for the human scale, claiming that “*small is beautiful*” and promoting a type of “*economics as if people mattered*” [12]. The idea of appropriate technology informed a new movement in rural development approaches worldwide. The core concept of “appropriate technology” was later changed to “intermediate technology” [13]. The appropriate technology movement (ATM) advocates the use of resources available in the specific locality: in rural situations, this usually implies small-scale but labor intensive technology and rural development based on capacity building and technology transfer instead of capital, technology and knowledge intensive alternatives. Examples of appropriate technology are hand-operated water pumps, solar cookers and rainwater harvesting. Worldwide, Appropriate Technology foundations were set up from the 70s onward, increasing their involvement in bottom up rural development [14–16].

With regard to energy policy, the appropriate technology protagonists advocate “*soft energy paths*” or “*appropriate renewable energy technologies*” [17]. This means that the energy technology choice is based on social and environmental criteria rather than on technological or economic criteria. This results in a technology choice for off-grid, decentralized solutions that might be suboptimal from an

economic or technological point of view, but are preferred when the social perspective is taken into account. An examples of appropriate renewable energy technology is energy derived from small-scale solar panels, micro-hydro-, biogas- or biomass installations.

The concept of appropriate technology has received its fair deal of criticism. Some authors from a political science point of view put appropriate technology in the light of dependency theory and argue that the ATM deliberately disseminated inferior technology to maintain power relations between the north and the south [18]. Other authors from a technological point of view criticized the ATM for disseminating ineffective technologies. From an economic perspective, the ATM has been criticized for providing solutions that are not economically viable and do not have a market. Besides such scholarly challenges, promoters of appropriate technology also encountered resistance to innovation in the field, depending on the level of technology and conformity with local collective values [19]. Despite all this criticism about the implementation within academia, the philosophy of appropriate technology is still informing the activities of many Indonesian NGOs and associations today, including YDD.

3.2. Project Financing through Carbon Emission Reduction Trading

A second driver for YDD to get involved in jatropha was the opportunity to get access to a new source of financing for program activities through carbon credits under the Clean Development Mechanism. The Clean Development Mechanism is one of the three flexibility mechanisms under the Kyoto Protocol that regulate carbon trading. Under the Kyoto Protocol, countries have committed themselves to a reduction of greenhouse gas emissions. The Kyoto Protocol assigns maximum emission rights to each country, which can assign these emission rights to their industry. In order to improve the cost-effectiveness of the emission reduction, the Kyoto Protocol contained three flexibility mechanisms; Joint Implementation, International Emission Trading and the Clean Development Mechanism [20].

The Clean Development Mechanism has two objectives: reducing carbon emissions and sustainable development through technology transfer. CDM allows industrialized countries to offset their excess carbon emissions by investing in clean technology development in developing countries. Industrialized countries can “buy” additional emission rights through trading in carbon credits or Certified Emission Reductions (CERs). A carbon credit is a financial unit used to measure the reduction of greenhouse gas emissions (1 CER = 1 ton CO₂ reduction). CERs are generated through the implementation of clean technology projects in developing countries that reduce greenhouse gas emissions. Investing in these green technology projects might be more financially attractive for industrialized countries than reducing emissions at home. Certification however is a cumbersome and complicated process. In order to certify the emission reductions from a project under the CDM scheme, a project developer has to go through various steps in the CDM project cycle in order to guarantee the existence, permanence, additionality and traceability of the emission reductions by project activities (See Figure 1) [21].

In order to calculate the project’s emission reductions, a project has to adhere to a specific “methodology”, which in CDM terminology refers to a set of rules and formulas on how to calculate the greenhouse gas emission reductions that can be attributed to the implementation of a specific technology. Basically there are two types of “methodologies”. The baseline methodology is a means to

estimate the emissions in a scenario when nothing is changed. The monitoring methodology is a means to calculate the actual reduction of greenhouse gasses due to the clean development project. The current methodologies can be divided into several categories depending on the type of project activities, including: large scale, small scale, afforestation/reforestation, and carbon capture and storage methodologies. There are over 200 methodologies [22].

Figure 1. Clean Development Mechanism (CDM) project cycle.



Important concepts for CDM include the principle of “additionality” and “leakage”. With regard to the concept of additionality, the project leader needs to prove that emission reduction would not take place without the financial support through the CDM mechanism, for example by showing that the jatropha project is not economically feasible without the additional income through carbon trading. It should also be additional to official development assistance (ODA) obligations of the involved industrialized country. The Conference of Parties has agreed upon excluding ODA from eligibility under the CDM scheme to prevent the diversion of ODA funding [21].

The project is also not allowed to cause “leakage”. This means that the project should not cause additional greenhouse gas emissions. Leakage can be caused in various ways. First, leakage can be

caused by the displacement of pre-project activities. For example if jatropha plantations displace cattle; in that case it is likely that the jatropha plantation will lead to indirect land use change, e.g., deforestation for the opening of new grazing fields. Secondly, leakage can be caused by emissions from the production process of renewable biomass, for example from fertilizer applied to the land, emissions from land clearance, seedling cultivation, emissions from unprocessed seed cake or the simultaneous combustion of diesel and biofuel in electricity generators. Finally leakage can be caused through the competing use of biomass.

4. Jatropha and CDM Worldwide

At the peak of the jatropha hype, there were high expectations for the potential of jatropha in the international carbon market, both in voluntary and mandatory emission trading schemes. Emission offsets can be traded in mandatory schemes (e.g., CDM or the E.U. emission trading scheme), or through voluntary schemes. The price of CERs used to be relatively higher than the price of emission reductions in voluntary schemes, such as Verified Emission Reductions, as they could not be counted under obligatory emission reductions.

Jatropha became associated with the “carbon gold rush” and as such attracted “carbon cowboys”; brokers who tried to make money out of the emerging carbon economy [23]. According to a worldwide study on jatropha in 2008 by the Global Exchange for Social Investment (GEXSI), actors in Asia were the most active in exploring the opportunities of CDM (39%) followed by Africa (20%) and Latin America (10%). Problems that were reported by pioneers in the field were the development of methodologies and the establishment of the organizational structures at the local government level as required by the United Nations Framework Convention on Climate Change [24,25].

CDM brokers like JATRO claimed that various activities in the jatropha value chain could contribute to greenhouse gas emission reductions compatible with CDM methodologies, including: (A) the rehabilitation of degraded land (carbon sequestration through planting jatropha trees); (B) the generation of renewable energy (electric and thermal power generation from residual jatropha biomass and biogas); (C) fossil fuel substitution; and (D) the production of organic fertilizer (as substitution to nitrogen based fertilizer) [26].

The main focus, however, was to gain carbon credits through the establishment of jatropha plantations under small-scale afforestation/reforestation methodologies. Life cycle assessment studies of jatropha claimed that jatropha could be a promising crop for carbon sequestration [27]. Some even stressed the “*robust opportunities and the high potential for jatropha to attract carbon credits under the Clean Development Mechanism*” [28]. The estimates concerning greenhouse gas reduction from jatropha plantations vary widely in the literature, from 5.5 ton CO₂/year/ha [29] to 17–25 ton CO₂/year/ha [30].

Jatropha plantations became translated into “energy farms” or “carbon farms” [30]. Jatropha was deemed particularly suitable, as it would be able to grow on marginal and severely degraded land, and hence avoid competition with food crop cultivation and indirect land use change. Degraded land was assumed to have little vegetation and hence small carbon stocks, resulting in a net positive carbon balance after conversion to jatropha plantations. Furthermore, a jatropha plantation with processing facility could be eligible for several methodologies under the CDM scheme, deriving carbon credits from several project activities.

The potential impact on greenhouse gas reduction depends on the type of land that is converted to jatropha plantations and the above and below ground carbon stocks. Only after 2008 more critical studies started to emerge demonstrating that the carbon storage potential of jatropha was limited and comparable to carbon stocks of fallow land at best. Authors such as Fargione and Romijn even warned of the possibility of creating “carbon debts” when tropical woodlands with considerable biomass were converted to biofuel plantations [31,32]. More recently, scholars have been exploring the negative environmental impact caused by jatropha processing on soil and water quality [33].

Currently there is only one jatropha project approved under the CDM scheme worldwide. This is the SOCCOCIM project in Senegal, where a cement producer adds whole jatropha fruit and other biomass (rice husk, cashew nut shells and cotton seed shells) to coal in order to generate heat for the production process of cement. Only three other jatropha related projects have been proposed to the United Nations Framework Convention on Climate Change (UNFCCC), but for all of them the validation has been terminated by the Designated Operating Entity (See Table A1).

5. Jatropha and CDM in Indonesia

The government of Indonesia signed the Kyoto Protocol in 1997 and ratified it in 2004 [34]. Following up on the Bali Action Plan and agreements made at the previous Conferences of Parties, and the G20 in Pittsburg in 2009, the Indonesian president formulated a National Action Plan for Green House Gas Emission Reduction in 2011. The government of Indonesia committed itself to a “low carbon development path” and formulated emission reduction targets, even though the government of Indonesia was not bound to emission reductions as an economy in transition. The government of Indonesia committed to a reduction of no less than 26% by 2020 by own means and up to 41% if assisted through international cooperation. This is a considerable commitment, when compared with the obligatory commitment of at least 5% below 1900 levels for industrialized countries during the first commitment period between 2008–2012. The commitment to reduce greenhouse gasses offered a huge financial potential for rural development. The Ministry of Environment formulated a special action plan to combat climate change [35] and its principles became integrated in national mid-term development planning for 2010–2014 [36] and the action plan to reduce greenhouse gas (GHG) emission in 2011 [37]. With the assistance of international cooperation, the reduction of greenhouse gasses could also form a new way of financing rural development. The Designated National Authority (DNA) in Indonesia, the National Council on Climate Change, was established in 2008 including a special division to deal with the Carbon Trade Mechanism. The National Council on Climate Change has the authority to approve CDM projects in Indonesia (See Figure 1).

The developments in the emerging carbon economy were followed with interest by the Indonesian Agency for Agricultural Research and Development of the Ministry of Agriculture. In cooperation with the Agricultural Institute of Bogor, they conducted a study in 2008 on the potential of jatropha as a carbon sink [38]. Anticipating the successful implementation of the national biofuel program, which mainly focused on the promotion of palm oil and jatropha as biofuel feedstock, the report concluded that jatropha had a great potential and would play an increasingly important role at the national level to achieve greenhouse gas reductions. Jatropha became intertwined with these programs. Jatropha was promoted as an interesting champion for rural development while at the same time combating the

climate and energy crisis. The claim that it was suitable for degraded land stressed the potential for semi-arid and poverty ridden areas like East Nusa Tenggara province in Indonesia.

The conclusion that jatropha was a suitable candidate for generating carbon credits, however, only took into account the biological aspects of carbon sequestration, and not the governance aspects. Despite the positive message of the Agency for Agricultural Research and Development, practical experience proved to be very different. In 2008, GEXSI reported that around 75% of the jatropha projects in Indonesia aimed to target carbon credits, mainly under the CDM scheme, which is high when compared with other countries in the report [24]. Despite this interest, no Indonesian jatropha related CDM programs have been registered at the UNFCCC database to date.

Several actors have made efforts to get the emission reductions from their project certified under the CDM scheme in Indonesia. PT Indocement for example, had been exploring the potential to use jatropha biomass (fruit shells) in their production process, comparable to the abovementioned Senegalese project design (see Section 4).

Other jatropha related projects have explored the possibilities of carbon credits under the CDM methodology for “fuel switch in household energy use” such as Bosch Siemens Hausgeräte GmbH (BSH) with the Protos plant oil cooking stove [39].

BSH explored the opportunities under the methodology with an innovative technology based on the gasification of plant oil. BSH is one of the major producers of household appliances in Europe and had the ambition to expand their market for household appliances to Indonesia, selling “low cost, appropriate” solutions affordable to the average household in Indonesia. The certification under the CDM scheme eventually failed because of problems with double counting. Nevertheless, BSH managed to get the project accredited under the voluntary scheme for “Gold Standard” while pending CDM approval. The Protos stove was distributed to farmers in Java by PT Waterland, a Dutch company involved in developing a jatropha plantation in cooperation with the Ministry of Forestry of Indonesia. Eventually, BSH published the technology and discontinued the production because of maintenance issues and difficulties with setting up a supply chain for sustainably cultivated plant oil [40].

Another actor exploring the opportunities of CDM financing for jatropha is Eco Carbone. Eco Carbone is an Indonesian consultancy firm focused on the identification and preparation of documentation for CDM projects. Eco Carbone has jatropha projects in various countries, including the jatropha community program in Papua province, Indonesia. Eco Carbone was also involved as consultant in the jatropha project in Mali (See Table A1). Eco Carbone succeeded in registering their jatropha project in Mali under the Verified Carbon Standard in May 2012. The Verified Carbons Standard is a global benchmark for carbon offset trading in the voluntary market. It can be considered as a marketing label guaranteeing the environmental sustainability of carbon credits sold, by performing a quality check. The experience in Mali with the voluntary carbon-trading scheme will be used for jatropha projects in Laos, Vietnam and Indonesia. Eco Carbone is still pursuing certification for some projects under the mandatory CDM afforestation/reforestation scheme. These projects however, do not include jatropha, but acacia.

The opportunity of future financing for jatropha projects inspired many actors worldwide to venture into jatropha cultivation and processing. The high expectations, however, proved to be difficult to realize. Very few projects actually entered the validation and verification procedure of CDM and only one project actually got certified. Jatropha projects proved to be more feasible under voluntary

schemes, see for example the cases from HIVOS [25]. To understand the type of barriers encountered in jatropha projects that are problematic for accreditation under the CDM scheme, the paper will now focus on the case study of YDD.

6. YDD's Appropriate Technology Approach to Rural Development

The YDD/APEX case study explores the experiences of the NGOs in trying to get their project certified under the CDM scheme. Founded by four idealistic engineers in 1972, YDD grew out to become one of the most well reputed NGOs in Indonesia. Their main focus is on water and sanitation programs, but the NGO has extended its activities to livelihood programs aiming at improving the socio-economic position of poor households. Projects are geared towards the generation of additional income through home industries, community based tourism and small agribusiness. Today the NGO has activities in micro financing, waste and water treatment, agriculture, aquaculture and renewable energy. YDD has offices in Yogyakarta, Bali, Maumere and Larantuka and offers employment to more than 300 Indonesians.

The renewable energy programs of YDD are in line with the “soft energy path” (see Section 3.1). The projects of YDD are based on low carbon technologies, aimed at reducing energy consumption and greenhouse gas emissions, while at the same time increasing the living conditions of the poor. The focus is on low cost technologies.

One example concerns improved cooking stoves that are designed to reduce firewood consumption. Due to the improved design, the combustion of biomass takes place in a more efficient way and less heat is wasted than with the use of traditional stoves. These stoves therefore reduce the demand for wood, abating the effects of deforestation. The stoves also have positive health effects for women and children as they reduce the exposure to indoor air pollution.

Besides household energy programs, YDD also focuses on energy generation for small-scale industries and the processing of agricultural products. One of their innovation activities is the gasification of biomass. An experimental setup with a gasifier is installed at their main office in Yogyakarta.

Another low carbon technology is focused on the improvement of sanitation. In cooperation with SIMAVI and funded by DGIS, YDD implemented the solar disinfection program. With this technology, water for households is purified through storage in plastic bottles under the sun. The ultraviolet radiation from the sun purifies the water from pathogens that are the cause of diarrhea. This technology reduces household consumption of wood fuel as the conventional method used for purifying water is boiling.

The jatropha project seemed to fit seamlessly into these previous activities because it fitted both activities related to renewable energy and small agribusiness. The jatropha project could be implemented at small scale, generate additional income, create employment in rural areas for an uneducated labor force, contribute to the electrification of remote areas and would be derived from renewable sources. The NGO propagated the use of seedlings from local provenance, so that there was no need to procure seed material from somewhere else. The seedlings were made by the local population under technical guidance of NGO staff. As a renewable energy project, jatropha diverged from the previous projects in that it was not geared towards the reduction of energy consumption, but

towards the production of energy from renewable resources. Still, jatropha fitted the narrative of this NGO's appropriate technology paradigm.

6.1. YDD Project Narrative: The Rehabilitation of Degraded Land with Jatropha

In 2009, YDD started the jatropha project called “*The Environmentally Friendly Development by Multiple Use of Jatropha Curcas in Indonesia*”. The project was located in the Sikka District, East Nusa Tenggara Province, Indonesia. The program echoed the objective of the government's “National Movement for Poverty Alleviation and Energy Crisis through the Reforestation of 10 million ha of degraded land with biofuel crops”. There is no clear consensus among ministries about the exact definition of “degraded land”, except for the claim that if biofuel is cultivated on degraded land, there will be no competition with food crops. Just like the national program, YDD claimed to be targeting exclusively the severely degraded hills in Magepanda sub-district for planting jatropha. This land is not used for agriculture and the current vegetation is dominated by grassland. The grassland is used for livestock grazing. Before the rainy season the grass is often set on fire. Fire is still a commonly used management tool in shifting cultivation systems and for maintaining grassland in NTT, despite prohibiting local regulations [41].

According to project documentation, the project was the result of a village consultation in 2007. The practice of villagers' use of fire for maintaining grassland, opening new plots of land and for hunting has had a negative impact on the environment. Deforestation had been leading to the depletion of water resources and during the village consultation the village administration recognized the need to rehabilitate the degraded lands and asked YDD for assistance. According to the project proposal, “*the multiple use of jatropha will not only improve the financial feasibility of the project but also fertilize the land through the planting of jatropha, contribute to the sustainable production of biomass and mitigate water shortage. The project aims to create a model that, while preserving the environment, also increases the income and improves the quality of life of the local population*” [10].

The jatropha project was financed by the Japanese Ministry of Foreign Affairs from a fund for Japanese NGOs. The Japanese NGO APEX (Asian People Exchange) received a grant with YDD as Indonesian counterpart (JPY25 million). The project was implemented in cooperation with two Japanese NGOs with an extensive experience in appropriate technology and a keen interest in jatropha development worldwide, namely APEX and JATI (Japanese Appropriate Technology Institute). YDD and APEX/JICA (Japan International Cooperation Agency) have previously collaborated in the establishment and management of an appropriate technology center for wastewater treatment in Yogyakarta. JICA had shown considerable interest in developing jatropha projects worldwide as part of Japanese ODA assistance, and had been financing jatropha plantations and research and development activities in Vietnam, Tanzania, Mozambique and Botswana including technical assistance to developing countries for the implementation of the CDM scheme. Together, APEX and YDD established the Appropriate Technology Center for Jatropha.

YDD made a demonstration plot for cultivating jatropha close to the collection center and started with the production of high quality saplings from cuttings of jatropha originating from local jatropha plants. The NGO assumed that individual smallholders would be motivated to cultivate jatropha by seeing the examples in this demonstration plot and having access to the inputs that YDD could provide

them. YDD anticipated that the farm gate price for jatropha would be a third driver for smallholders to engage in jatropha cultivation. Therefore, it advertised the intended farm gate price of jatropha seeds on banners attached to the collection center.

Besides investing in upstream activities (jatropha nursery and promoting jatropha cultivation), YDD also made a link with downstream activities (jatropha oil production and trading). YDD constructed the necessary infrastructure unique to the region, including a processing plant, storage facility and two collection centers. They managed to reach an agreement with the local branch of the state owned energy company related to the consumption of jatropha oil in the local diesel operated electricity generator. This memorandum of understanding was extended in 2011 during a national conference on jatropha organized by the NGO. In the memorandum of understanding the local electricity company expressed its intention to purchase the jatropha oil produced by YDD. The price would be established through negotiation and should benefit both parties. Up to 2012 no purchase agreement had been signed, as YDD could not guarantee a steady supply, as they were not producing oil in large enough quantities due to a lack of feedstock. The farmers were not motivated to cultivate jatropha for the price offered by YDD. Instead they preferred to give priority to agricultural commodities with a better price and more secure demand such as cashew or cassava. After YDD had closed the collection center, villagers got the impression that the project had ended.

6.2. Combining Global Discourses and Local Concerns in a CDM Project Design

Through their activities with the efficient cooking stove program and water purification system, YDD was embedded in a wide network of international NGOs exploring the opportunities for bringing low carbon technology projects under the Clean Development Mechanism by developing new methodologies. YDD for example was the secretariat of the Asian Cooking Stove Program or ARECOP. ARECOP is a network of NGOs with a special interest in improved cooking stoves and biomass energy programs in Asia. ARECOP explored the opportunities for making improved cooking stove technologies eligible for carbon trading.

At the time, there were already several methodologies available for cooking stove programs and in Indonesia one cooking stove program in Kupang had been approved under the methodology for “thermal energy production with or without electricity” [42]. The technology of water disinfection by using ultraviolet radiation from sunlight and the ceramic water filter projects were added to the approved methodologies for household water treatment technology named “low greenhouse gas emitting water purification systems” [43]. The NGO also started to explore what methodologies could possibly be applicable to jatropha activities in various phases of the production chain from cultivation and processing to consumption.

In 2009, APEX and YDD requested assistance of an experienced and relatively successful CDM consultancy firm named Mitsubishi UFJ Securities to make a feasibility study of the jatropha project. Mitsubishi UFJ Securities Co. Ltd. (MUS) is a consultancy company providing brokerage and investment banking services. The consultancy company was also the consultant for the Project Design Document (PDD) of the jatropha project in Vietnam (See Table A1). The validation and certification procedures are so elaborate and difficult that it is hard to fulfill all the administrative requirements without the assistance of such a specialized expert. The consultancy firm has a special operating unit

called Clean Energy Finance Committee, specialized in climate change and offers assistance for CDM projects. The product or service promised on their website is a project design document that “*move[s] smoothly through the validation/determination process*” [44]. The consultancy firm also offers brokerage in order to find a buyer for the carbon credits. The company prides itself on being one of the leading consultancy firms in new methodology development.

In 2009 the consultancy firm was commissioned to conduct a feasibility study on the YDD projects. The applicable methodologies that were explored for the CDM program were “electricity generation by the user” and “plant oil production and use for transport applications”. The baseline scenario of the project assumed the continuation of fossil fuel use by the electricity company for the generation of electricity. The reduction of emissions would be created by the project through the substitution of fossil fuel with the jatropha oil in the diesel operated electricity generators of the electricity company.

The structure of the project design reflects the available methodologies under which jatropha would be eligible under the CDM scheme. All the aspects as mentioned in paragraph 4.0 were included in the project design of YDD (See Figure 2), including (A) the rehabilitation of degraded land (carbon sequestration); (B) the generation of renewable energy (electric and thermal power generation from residual jatropha biomass and biogas); (C) fossil fuel substitution; and (D) the production of organic fertilizer (when substituting the use of nitrogen based fertilizer). The activities within the upper box were identified as “inside the project boundary”. These activities fit the global narrative on climate change and are structured according to CDM methodology. The activities within the lower box were considered to be “outside the project boundary” for the calculation of greenhouse gas reductions under CDM. The reduction of fuel wood consumption through the production of potable water was not accounted for. Still these activities were included in the overall project activities of YDD in order to accommodate local concerns.

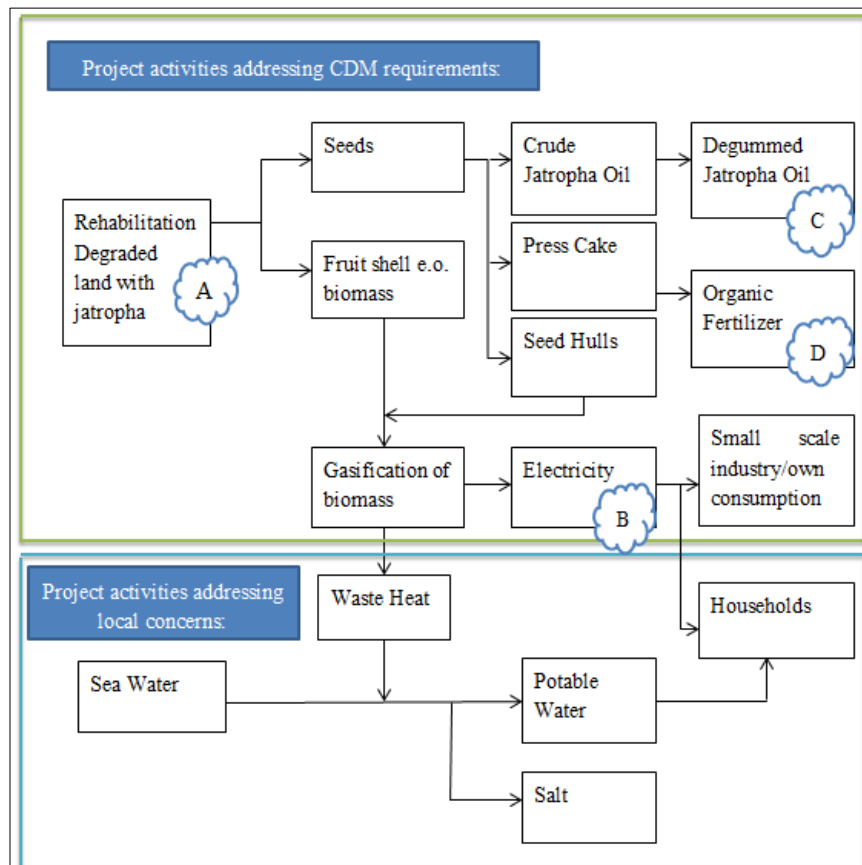
It appears as if the project design had been severely influenced by the available methodologies under CDM, including the choice not to opt for further chemical processing of jatropha oil to biodiesel. According to the NGO, this choice of technology was made to make the process simpler as it would have to be carried on by the local population without external support. This choice also made the production process cheaper as there was no need for additives. An advantage of not further processing the jatropha oil is the reduction of wastewater from the industrial process. Another factor that might have influenced this choice is that the chemical process of (trans)-esterification contributes to the project’s greenhouse gas emissions.

The project however did not only follow the logic of available CDM methodologies. Local concerns have also been integrated in the project, but are situated outside the “project boundary”. This means that the greenhouse gas emission reduction caused by the desalinization of seawater by waste heat is not added to the total greenhouse gas emission reductions of the project. An example is the desalinization of seawater to improve access to clean drinking water to the surrounding communities. Water can only be desalinized when jatropha oil is produced continuously as the desalinization process is dependent on the waste heat of the oil production process. As the capacity of the processing unit was not fully used because of the lack of feedstock, the desalinization installation was laying idle.

The conclusion of the CDM consultancy report was that the project would be feasible, but also mentioned that the methodology for plant oil production and use needed a revision to be applicable to the project. The NGO continued with the application and a request for “prior consideration of the

CDM-project design document form” was submitted to the secretariat of UNFCCC and the Indonesian National Council for Climate Change and was received at 28th of October 2009 (See Table A2) [45]. Eventually the project got stuck in the project-planning phase (scoping feasibility, designing project design document, validation and registration) and never reached the project implementation phase (verification, certification and credit acquisition) of the CDM project cycle. The following paragraph will discuss various challenges towards implementing jatropha as a CDM project.

Figure 2. Project design integrating local concerns and CDM requirements.



7. Friction between Global Narratives and Local Practices

The implementation of jatropha projects under the CDM proved to be problematic, not just for the YDD project. Factors causing barriers for such implementation included the ambiguity in the operational definition of “forest”, the absence of CDM methodologies readily applicable in biofuel projects, and incompatibility between the small-scale system as appropriate for jatropha cultivation and the requirements for monitoring from the CDM. Furthermore the current market conditions for CERs have deteriorated compared to the situation during the initial years of carbon trade.

7.1. Challenge 1: Core Definitions, What Is a Forest?

One of the issues that troubled the prospects of jatropha plantations being implemented under the afforestation/reforestation CDM scheme in general was related to the operational definition of forest in Indonesia [46]. The definition of “forest” is a political sensitive issue in many countries

and was left to the authority of the member parties' national governments. The CDM definition of forests includes ranges for minimum forest tree crown cover (between 10%–30%), for a minimum land area (between 0.05 and 1 ha) and for a minimum tree height (between 2 and 5 m) [47]. Under the Marrakech Accords, which stipulated the operating rules for the Kyoto protocol, it was decided that every country could formulate its own definition of forest within these ranges.

To support the afforestation/reforestation program under the CDM, the Indonesian Ministry of Forestry formulated the national definition of forest for the implementation of CDM concerning the rules and procedures for implementing afforestation/reforestation CDM projects [48]. In Art. 33.1 of Government Regulation No. 6/2007 [49], it states that the categories “production forest” and “protected forest” can be used for ecosystem services, among which carbon sequestration. Licensing procedures for ecosystem services are described in regulation of the Ministry of Forestry in 2009 [50]. According to the Indonesian definition, forest should have a minimum tree crown cover of 30%, a minimum potential height of 5 m and a minimum land area of 0.25 ha. These thresholds are important as they determine the amount of land and the type of afforestation/reforestation activities eligible under the CDM scheme [51]. A higher threshold for minimum tree cover for example increases the land eligible for afforestation/reforestation CDM projects. A higher threshold for minimum tree height, however, limits the types of re-vegetation eligible as “afforestation/reforestation” activities.

This is especially problematic for semi-arid to arid areas in Indonesia, where it might be difficult to fulfill these criteria because of what has been designated administratively as “forest” in these areas includes savannah with a characteristic dispersed vegetation of short trees and shrubs. Even though some authors have already argued that the concept of “forest” is too rigid and that one should look at the additional carbon storage created by the re-vegetation activities, current carbon storage methodologies are still dependent on the definition of forest instead of a calculation of carbon stored in vegetation cover. By making other types of re-vegetation—including with shrubs like *jatropha*—eligible under CDM, it would be possible to also include smallholder agroforestry projects instead of just large-scale monoculture plantations [52]. Due to the Indonesian definition, afforestation/reforestation methodologies for *jatropha* plantations are excluded, as it will be hard to meet the forest threshold as established by the authorities [53]. Additional to these national conditions there are other barriers related to afforestation/reforestation projects as discussed by Thomas *et al.* among which the high risk associated with the permanence issue, the lack of revenue in the first years of the project, the actual planting costs *etc.* Despite the high expectations of the afforestation/reforestation methodology, only a fraction of the projects in the CDM pipeline made use of this methodology (around 0.2%) [54].

7.2. Challenge 2: Availability of CDM Methodologies for Biofuel as Renewable Energy Source

The availability of alternative approved methodologies for *jatropha* activities, such as for biofuel as alternative energy also appeared to be problematic. Other methodologies for biofuel were already available, but they were only applicable to biofuel derived from waste oil and animal fat. The 2009 methodology approved the production of biodiesel from plant oilseeds, provided that the seeds came from plants cultivated on “dedicated plantations on degraded land”. For a while, *jatropha* entrepreneurs therefore focused on the CDM methodology for afforestation and reforestation, even though they could also have opted for calculating the gains to greenhouse gas reduction from substituting fossil fuel by

jatropha based biofuel. The problem was that in the first years, no baseline and monitoring methodologies had been approved yet for biofuel derived from oil seeds so that such gains for GHG reduction could not be calculated.

Only in 2009 the CDM methodology for the “production of biofuel as use for fuel” [55] was approved by the executive board of CDM. According to this CDM methodology, only “*vegetable oil that is produced with oil seeds from plants that are cultivated on dedicated plantations established on lands that are degraded or degrading at the start of the project activity*” is eligible as “biofuel” under the CDM methodology [55]. Plantations qualify as “dedicated” if they are “*established as part of the project activity for the purpose of supplying seeds*” to the project’s processing factory. In order to identify degraded land, the CDM developed a tool, basically determining that degraded lands are defined by the national government in the respective country [56].

The CDM methodology for the “production of biofuel as use for fuel” was revised in 2010, excluding the use of peat land for afforestation/reforestation projects because of the carbon stocks in degraded areas. These definitions did not exclude drainage of peat land for the establishment of palm oil plantations. This revision also excluded the consumption of biofuel from the project boundary. This revision was made to prevent “double counting”. Double accounting occurs when rights to CERs from emission reductions are claimed by two parties in the production chain. This can happen easily in complicated production chains where projects might overlap. In the case of YDD, there is the risk that both YDD and the electricity company claim rights to CERs due to carbon emission reduction: YDD through the production of biofuel and the electricity company for substituting fossil fuel with biofuel in their power plant. To avoid the risk of double counting, biofuel producers using the methodology for substitution of fossil fuel with biofuel can only claim CERs if the consumers are included in the project boundary and if they are monitoring the actual consumption of biofuel by the end user [57]. This can be guaranteed through a contractual agreement granting the exclusive right to claim CERs to the project proponent.

These experiences show that Jatropha entrepreneurs had to invest significantly not only in their project activities but also in the development of new CDM methodologies in order to get their emission reductions certified under the Clean Development Mechanism. Just like YDD, many entrepreneurs did not have this knowledge and had to commission a carbon broker or consultancy firm specialized in developing new methodologies.

7.3. Challenge 3: Incompatibility between Local and Global Development Discourses within the Project

A third barrier for implementation of jatropha projects under the CDM scheme was formed by the monitoring and reporting requirements of CDM. These requirements almost implicitly require a specific type of production and scale and appear to be biased towards large-scale plantations. Such requirements are incompatible with the characteristics of small-scale systems in which smallholders are not integrated in a large-scale scheme and cultivate their energy crop in a mixed agroforestry cultivation system. With these stringent requirements, the CDM shoots past the goals of green technology transfer and sustainable development. Under the current conditions, CDM is not economically feasible for smallholders as the transaction costs are too high. Only large companies like PT Indocement might have the means to bridge the period between project initiation and carbon

revenues as significant amount of time and resources are needed to develop new methodologies and successfully complete the validation and certification process.

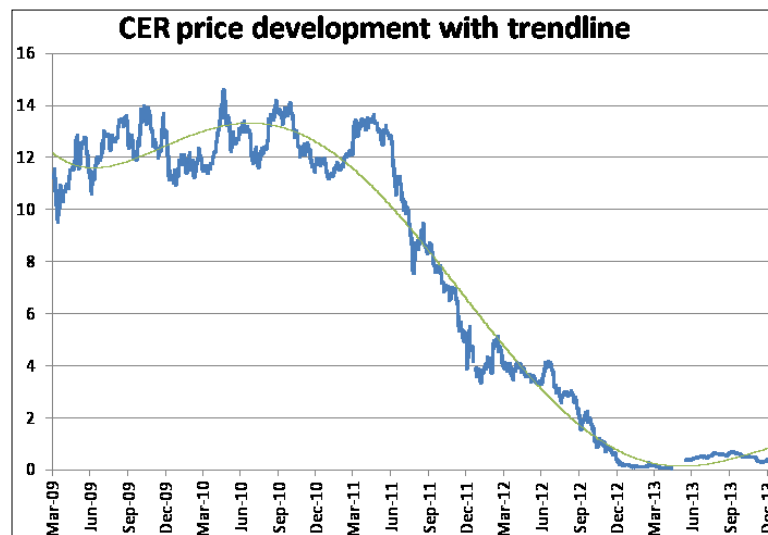
Another issue is the administrative requirements of CDM at the local level. There is a growing concern related to the socioeconomic benefits of CDM projects and the importance for rural development [45]. Mudiyarso and Noordwijk already stressed that criteria such as the “*perceived level of administrative preparedness*” at the district level and “*connectedness*” proved to be more important selection criteria for the location of CDM projects than poverty and development criteria [58].

The fact that YDD had been motivated in its project design by local needs resulted in a “business model” of jatropha that diverged from the more common pattern in which jatropha companies focus on acquiring access to land through concessions or land acquisition. Instead, YDD’s focus was on technical aspects such as providing quality seedlings and technological guidance to the farmers, assuming that these services would sufficiently motivate farmers to cultivate the crop. The philosophy of YDD is to develop community based jatropha cultivation exclusively on degraded land and not to sacrifice agricultural land for biofuel crop cultivation. YDD aimed to develop biofuel for the benefit of local interest. The consequences of this choice have been twofold. First, the NGO experienced difficulties securing feedstock for their processing plant, because many farmers preferred cultivating other crops. The factory thus never operated on full capacity. Second, the limited oil production made it difficult to fulfill all the monitoring and verification requirements of the CDM scheme.

7.4. Challenge 4: Unfavorable Conditions on the World Wide Carbon Market

In the meantime, a lot has changed in the international economy since the start of the Kyoto protocol. The value of CERs has been subject to macro-economic and legislative changes beyond the national borders of Indonesia. In the current carbon market there is an oversupply of CERs and a lack of demand. The financial crisis in 2008/2009 followed by the credit crisis and the ongoing recession in the E.U. have had a significant impact on the price development of CERs (See Figure 3).

For a long time, the value of CERs has been following the price of European Union Emission Allowances (EUA). The European Union Emission trading schemes allowed for compensation through purchasing CERs. Therefore, Europe has been the main buyer for CERs produced worldwide. The prolonged economic recession has had an impact on industrial production in general, leading to fewer emissions than assumed under normal conditions. Consequently, the need to compensate for greenhouse gas emissions evaporated. Between 2009 and 2011 the price of CERs has been low but stable. The second downturn started at the end of the first commitment period of the Kyoto protocol in the beginning of 2012. At the 18th Conference of Parties in Doha, Qatar, the parties agreed on a new commitment period, and agreed to negotiate a new legally binding international climate treaty by 2015. No legally binding commitments for future greenhouse gas reductions were made. Some parties even withdrew from future emission reduction in the second commitment period, including Japan, New Zealand and Russia. Under these changed conditions jatropha-CDM projects are not economically feasible because the transaction cost for getting certified are higher than the benefits derived from carbon credits [59].

Figure 3. Certified Emission Reductions (CER) price development between 2009–2013 [60].

8. Conclusions

This article analyzed the main drivers for a large Indonesian NGO to start a jatropha project in a remote and arid area of Indonesia. First, jatropha was a logical continuation of the NGO's previous activities in the area of new and renewable energy and small-scale agribusiness. A second driver was the opportunity of getting access to new sources of funding through the Clean Development Mechanism. The set-up of the project was made possible by the availability of donor funding from the Japanese government for jatropha projects, which was, however, not extended after 2011. According to the project manager, activities would continue after the termination of the YDD project, under the authority and management of an independent business entity, the Appropriate Technology Center for Jatropha (*Yayasan PUSPHA*).

The local drivers for this project turned out to be largely based on assumptions that have not been validated by practical experiences. The need for land rehabilitation in order to restore local water sources was not enough to motivate farmers to maintain the jatropha plants. Due to the low farm gate price, farmers were not motivated to convert large plots of land to jatropha plantations. When the project activities slowed down, lots of plants were damaged by fire in the dry season or replaced with other crops. Combining the global and local drivers, YDD made important achievements in linking the upstream part of the jatropha value chain where jatropha is being produced with the downstream activities of biofuel processing and marketing. Yet, despite these accomplishments, the continuity of the project was still dependent on external funding, human resources and technology. In spite of the short duration of funding for the YDD project and its limited success, it provides an important case for learning lessons about the application of the CDM scheme in practice.

The main barriers for getting jatropha projects recognized under the CDM scheme were related to four main categories. First several operational definitions, such as the definition of “forest” in Indonesia excluded jatropha based vegetation schemes. Secondly, biofuel entrepreneurs had to invest significantly in the accreditation of their projects, as applicable methodologies for calculating the emission reductions were still under development and not yet approved by the CDM executive board. Thirdly, there proved to be some friction between global development discourses and local practices.

The monitoring requirements of the CDM scheme practically excluded small-scale agro-forestry projects by smallholders, an important pillar within appropriate technology. Fourthly, the unfavorable conditions in the world market caused the price of CERs to plummet, making it unfeasible to go through the certification process.

Combined, these barriers explain why organizations engaged with jatropha cultivation and processing in Indonesia had a hard time getting their projects recognized under the CDM scheme. The lessons from these experiences in the field contest the positive expectations expressed in some recent studies on jatropha for carbon sequestration and land rehabilitation [61,62]. Even YDD, one of the oldest NGOs and supported by APEX, with ample experience in appropriate technology projects, did not manage to receive carbon credits under the CDM scheme. Actors such as YDD do not only need to have the technical knowledge at their disposal but also the creativity to generate a discursive commodity linking global discourses with every day practices. They need to have the capacity to generate “story value” through translating physical project activities into the technical jargon of CDM through “project narrative”. This project narrative is very important in legitimizing the project to both a global and local audience and should be addressing the selection criteria of CDM such as additionality, net increase in carbon emission reduction, leakage, double counting and negative social and environmental externalities.

The experience from this case shows that in order to obtain CERs, there is a strong need for specialized knowledge, brokers, technical data and facilities that are often not available in marginal areas. The CDM models and calculation methods seem to have been biased towards large scale monoculture and included requirements that could not be met by smallholders in small scale agroforestry systems. There also proved to be a disconnect between local and global aspirations as farmers were not motivated by the farm gate prices that YDD offered and were not warming up for land rehabilitation and climate change mitigation arguments.

The experiences of this NGO teach us important lessons for carbon governance in general like the post Kyoto carbon trading mechanism “Reducing Emissions from Deforestation and Degradation” (REDD+) [63]. The emerging carbon economy has the potential to become an important driver for large-scale land conversion [64,65]. In this particular case, large-scale land use change did not take place. What it does illustrate, however, is the potential vulnerability of farmers and NGOs to policy whims in national and global arenas. When the economic feasibility of a project is based on the future financial value of a legally constructed commodity like carbon credits, hypes such as with jatropha can easily result in land use change. When this land use change is based on discursive commodities like carbon credits, the sustainability will be vulnerable to changes in the normative setting that create this value. The study stresses the need for further research on long-term guarantees regarding the economic sustainability of low carbon technology transfers, spanning beyond the initial project period.

And finally, large national NGOs like the one discussed in this article appear to be adaptive learners and resilient to the negative consequences of changes in this normative environment. YDD have continued with both new donor funded projects, such as the toilet credit program, as well as their search for new commodities that can improve the livelihood of local people including the production of organic fertilizer from jatropha press cake and the introduction of new horticulture commodities such as rosella and dragon fruit. With regard to renewable energy, the NGO continued exploring the opportunities of biomass, this time in the form of using agricultural waste in order to generate electricity.

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Conflicts of Interest

The author declares no conflict of interest.

Appendix

Table A1. Jatropha related projects and status in CDM pipeline (as of October 2013) [66].

Project Title	Status	Methodology	PDD consultant	Buyer
Biodiesel Fuel (BDF) production from organic oils of Jatropha and usage in Vietnam	Validation terminated by DOE	AMS-III.AK. Biodiesel for Transport	Mitsubishi UFJ Securities	Japan (Revo International)
Mali Jatropha Curcas Plantation Project	Validation terminated by DOE	AR-AM14 reforestation	Eco-Carbone	Switzerland and France
Biodiesel production and sale from dedicated Jatropha Curcas plantations in the Democratic Republic of Congo	Validation terminated by DOE	ACM17 Biomass energy/biodiesel	GENIVAR	Canada (Carbon2green)
Partial Substitution of Coal by Jatropha Fruits and Biomass Residues in the Production of Portland Cement, Senegal	Registered	ACM0003 ver. 7 Biomass energy/ Agricultural residues	Yanbian Lonyuan Wind Power	Switzerland (RWE)

Table A2. Jatropha related projects that have requested for prior consideration [45].

Project Title	Company/organization	Host Country
Establishment of a Jatropha Biodiesel Production Project in Nigeria	Threshold Biofuel Energy Co. Ltd.	Nigeria
Jatropha Luxor	Bio Fuel Egypt	Egypt
Marinduque Jatropha Power	Garado Green Energy	Philippines
Environmentally Friendly Development by Multiple Use of Jatropha curcas in Indonesia	APEX	Indonesia
Jatropha based agro-forestry system and bio-diesel production in Kham District, Xiengkhuang Province, Lao	Lao Agro Promotion Company Limited	Lao People's Democratic Republic
cultivation of Jatropha Curcas and Moringa Oleifera in 50,000 ha of degraded land	Promethium Carbon	Ghana

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